PROSIDING PERKEM VII, JILID 1 (2012) 79 - 85
ISSN: 2231-962X

Macroeconomics and Industry Effect of an Increase in Fuel Price in Malaysia

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ABSTRACT

The general objective of this paper is to study the effect of an increase in fuel price on Malaysian economy. The motivation of the study is to reduce the increasing fuel subsidy in recent years as well as to decrease emission produced from transportation sector. The influence of fuel price on all industries and economic agents are estimated quantitatively using input-output table. Data is taken mainly from Input-Output Table Malaysia 2005. Meanwhile, data on fuel and emission is extrapolated from National Energy Balance. Two models are designed in the study. The first model incorporates carbon tax into the input-output table. The concern of this model is to recognize the extent of emission that could be reduced if carbon tax is introduced on industries. In the second model, the fuel subsidy is to be reduced. Fuel price in both models are expected to increase. These two models investigate its impact on demand and supply of input and output between industries. With fuel is one of inelastic input in almost all industries, both the carbon tax and the reduced fuel subsidy would lower industry output, employment and gross domestic product. Comparing the effect of both models, the negative impact of carbon tax on the economy is less than brought by the reduction in fuel subsidy.

Keyword: Fuel Price, Subsidy, Tax, Input-Output, Gross Domestic Product

INTRODUCTION

From the upward trend of the fuel consumption and CO2 emission in recent years, imported fuel and CO2 are expected to increase in the future. Since fuel is an intermediate input for almost all industries, the increase in oil world price would increase production cost and thus commodity price in Malaysia. As economy growth depends on export demand in Malaysia, the increased dependency on imported fuel would affect economy growth. Improving fuel efficiency and renewable fuel are suggested to reduce demand on fuel. Apart from stabilizing economy growth, the suggestion could also reduce emission from transportation sector. As transportation sector is the most polluting sector in Malaysia, a detailed study is done on how to reduce emission in this sector. The paper suggests reducing emission produces by goods vehicle. First, goods vehicle uses diesel as fuel and diesel pollutes more than petrol. Second, the emission is suggested to be reduced gradually. Instead of all household, the emission is reduced from producers first before involving all household. Malaysia has agreed to reduce up to 40 percent in terms of carbon intensity of GDP by 2020 compared to 2005 levels in the 15th Conference of the Parties (COP15). For this purpose, sustainable transport and sustainable fuel are suggested. Among the three tools to archive these two objectives include reduction in fuel subsidy, carbon tax on fuel are blending of palm oil into fuel. The cost and benefit of each tool is accessed and compared in the methodology part. As crude oil is expected to deplete after 16 years, sustainable transport and sustainable fuel are encouraged to be adopted from now.

LITERATURE REVIEW

Intensive working papers and journal have been published to study the impact of fuel price on reducing emission. Among the papers, Australia and Indonesia and Taiwan make a valuable effort in incorporating environment element into the model. The incorporation of environment element in model suits with the current greenhouse issue. Carbon dioxide (CO^2) is the type of emission that is mostly emitted in the atmosphere. This pollutant mainly comes from energy sector and energy-intensive sector. The energy-intensive sectors include manufacturing sector and transportation sector. Trade

activity that speeds up the energy use also contributes to the emission. To reduce emission, several instruments could be tested in some models to meet a target that only a certain level of emission could be produced. These models could estimate quantitatively the benefit and cost of environment policy based on an economic situation in a particular country. In general, the benefit of environment policy means the emission that the policy could reduce. Meanwhile, cost includes decrease in economy growth, employment and trade competitiveness.

In Australia, McDougall (1993a, 1993b) has empirically compares the effectiveness of carbon, energy and petroleum product taxes in reducing greenhouse gas emission in Australia. Carbon tax revenue is proportional to the size of the carbon tax. As its tradeoff, price of energy-intensive commodities and export price index increase. It results a loss in competitiveness among trade-exposed industries, both export-oriented and import competing industries. Consequently, demand for both domestically produced and export volume contracts, leading decrease in economy growth. Output of many industries decreases after carbon tax is imposed. Industry that is mostly adversely affected by the carbon tax is the mining and metal products industries. This industry is energy-intensive and carbon tax would definitely increase cost of this industry. Meanwhile the most adversely affected energy commodities are brown coal and non-ferrous metal. Decreased demand for output and increased cost cause producer to demand less labour. With fixed labour in the short run, employment reduces after economy growth falls. Because nominal wage has been set in wage contract, the inflation would reduce real wage if producer transfers the carbon tax to local users. Instead, producer unable to pass the higher energy cost on export sales because the demand of foreign market for exported commodities is relatively elastic. As country beside Australia produces similar commodities, the increased price of commodities might reduce export volume if exporter transfer the carbon tax on exported commodities. Although export demand does not influence much by carbon tax policy, the higher energy cost has reduced the demand for labour to produce exported commodity. This also contributes to decline in employment. To compensate for this effect, the carbon tax revenue is suggested to be returned to community by reducing income/indirect tax or implemented in stage. In McDougall (1993b), carbon tax is considered as a better instrument than energy tax to reduce emission because carbon tax could better discriminate emission through fuel switching to cleaner fuel in production process. From the simulation result, both energy tax and carbon tax reduce both the carbon dioxide emission and fossil fuel energy consumption. The potential for carbon tax to be better instrument than energy tax is enhanced when the simulation result shows that carbon tax could reduce both energy consumption and carbon dioxide emission more than the energy tax. In macroeconomics, real GDP, real national consumption, real investment and net export volume fall by around 1 per cent. Reason is that the energy and carbon taxes have increased the price of capital. To reduce production cost, producers thus reduce the demand for capital and instead shift to use more labour. Since labour is fixed in the long run, the excess demand for labour has pushed up the wage. Both the tax and increase in price of primary factor then increase further production cost of many industries. It thereby weakens the input-output linkage in industry and national demand.

Developing countries especially Indonesia and China often subsidize fuel to lower down the production cost. The common issue is that the inefficient use of energy has caused environmental problem. Transportation and industrial become the two main sectors that produce emission in developing countries. Emission thus needs to be internalized with instrument that is appropriate for the particular country. Taxing carbon and reducing fuel subsidy are the two most common policy instrument for this purpose. Their magnitude in reducing energy consumption and carbon emission is different. In addition, while reducing fuel subsidy would increase production cost, there is a possibility that producer might transfers tax to household. The cost and benefit of both instruments are compared in many papers. In Yusuf (2008), the simulation shows that while both instruments are effective, taxing is preferred in reducing emission. It is because with the same amount of government revenue saved from fuel subsidy reduction, this instrument could decline CO_2 emission with lower cost in terms of gross domestic product (GDP) reduction and better distributional effect. The same result is obtained whether the government budget surplus generated from increase in fuel price and carbon tax is redistributed to the household or not. This suggests that environment policy also produce income equality promoting at the same time. Thus taxing carbon is the better policy instrument for Indonesia suggested by Yusuf (2008).

After 1997 crisis, Indonesian economy survives due to agricultural output and agricultural exports. However, trade on agricultural product is increasingly hard to be sustained due to its relative lax environment standard. Thus trade liberalization might cause the environment-related problem. Export of these products has accelerated environmental pollution in Indonesia. In addition, agricultural output imported by Indonesia is produced with emission. Further trade liberalization could lead to lower welfare after considering the trade-off between economic growth and pollution. This issue has

been empirically studied by Abimanyu (2000). Since both Abimanyu (2000) and Yusuf (2008) incorporate environment in Indonesian data, both papers are compared. The latter focuses more on how environment is related with trade and the former emphasize on policy instrument in reducing emission. Particularly, Abimanyu (2000) analyzes the interdependence among trade liberalization, agricultural sector production activities and environmental pollution. Instead of focusing on one pollutant only as done by Yusuf (2008), he considers number of type of pollutants in his model. The pollutants considered include SPM, SO_2, NO_2, Lead, CO and BOD. From the result, ironically the cheaper imported agricultural import does not adversely affect environment. Instead, increasing fertilizer subsidy stimulates farmer to use more domestic fertilizer which is less environmentally friendly compared to imported fertilizer. Thus, although trade increases influx of dirty products, the imported agricultural inputs produces less emission compared to domestic agricultural inputs. Thus trade is not necessarily adversely affect environment as stated in pollution haven hypothesis.

RESULTS AND FINDINGS

Carbon tax on fuel and reduction in fuel subsidy would increase fuel price, and fuel is an inelastic intermediate input in transport margin. Carbon tax is imposed by increasing the commodity sales tax. Meanwhile, fuel subsidy is reduced by increasing its basic price. Below is the simulation done in this paper:

Simulation 1: Increase sales tax on all fuel (both petrol and diesel) by 5 percent
Simulation 2: Increase sales tax on petrol by 5 percent
Simulation 3: Increase sales tax on diesel by 5 percent
Simulation 4: Increase sales tax on producer by 5 percent
Simulation 5: Raise price of all fuel by 5 percent
Simulation 6: Raise price of petrol by 5 percent
Simulation 7: Raise price of diesel by 5 percent

While the first five simulations relates with carbon tax, the last three simulations relate with reduction in fuel subsidy. In the first simulation, sales tax on petrol and diesel is imposed on all fuel users by five percent. The fuel users include producer, investor, consumer, government and exporter. Meanwhile in the second and third simulation, sales tax is imposed on fuel users too, on either petrol or diesel, by the same percent. The fourth simulation slightly differs from the first three simulations. In the fourth simulation, the sales tax is imposed on producer only instead of on all fuel users. Also different from the first three simulations, the sales tax is imposed on all commodities instead of on fuel commodities only. Thus the first three simulations impose sales tax on fuel commodities only on all users, while the fourth simulation would impose sales tax on all commodities on producer only.

All the last three simulations assumes that fuel subsidy is reduced on fuel commodities only and is imposed on all fuel users including producer.

All simulations would increase fuel price. The higher fuel price is an instrument to reduce emission produced by transportation sector through a more efficient of fuel consumption in this sector. Results of carbon taxing and fuel subsidy reduction are compared in terms of macroeconomics and industry. Effect of these two policies on export is also discussed.

Macroeconomics Effect

Macro Variable	Simulation						
	1	2	3	4	5	6	7
Nominal GDP	-0.03	-0.02	-0.02	-0.68	-125.02	-66.73	-58.29
CPI	0.13	0.06	0.07	2.13	-11.74	-5.96	-5.78
Household consumption	0.13	0.06	0.07	2.13	-11.74	-5.96	-5.78
Aggregate employment	-1.06	-0.52	-0.55	-17.48	-11.04	-5.39	-5.65
Export	-0.38	-0.18	-0.19	-8.97	-5.61	-2.90	-2.71
Import	-0.13	-0.06	-0.07	-5.45	-4.28	-2.30	-1.97

Table 1: Change in Macroeconomics Variable After Shock

This table presents the effect in some important macroeconomics effect if the carbon tax and fuel subsidy reduction are implemented. Comparing the effect of carbon tax and fuel subsidy on nominal gross domestic product, household consumption, employment, export and import, the former policy brings a lesser adverse effect on economy than the latter policy in overall. However, the carbon tax policy would increase the general price level.

In particular, in the first simulation, the carbon tax on all fuel reduces the nominal gross domestic product about 3 percent than it would be if the carbon tax is not reduced. The effect on nominal gross domestic product is almost the same in the second and third simulations. Comparing the effect on other macroeconomics variables, carbon tax on all fuel affects the economy more than taxing on either fuel. No matter which fuel is taxed, the effect is almost the same. Comparing the second and third simulations, the impact of carbon tax on either fuel would increase price level and household consumption in same extent. The negative effect on aggregate employment, export and import is almost the same if taxing either fuel. Intuitively, carbon tax by five percent would raise the price paid by consumers relative to the price received by producer. As a consequence, producer especially in industries that are fuel intensive would react by reducing its output. The reduction in output by industry would then decrease the gross domestic product by 0.02-0.03 percent compared to a situation where carbon tax is not imposed. Since carbon tax would increase production cost, producer would transfer the burden to consumer by imposing a higher price on output. It explains the reason the consumer price level increases by around 0.1 percent after carbon tax is imposed compared to a situation where carbon tax is not imposed. The increase in price level automatically raises the household consumption as household spends more on the same goods basket after price level increases. Therefore the household consumption increases in the same proportion as the inflation. Since the carbon tax would raise production cost and also the decrease in price level would lower the real wage, the aggregate employment then decreases by about 0.1 percent if carbon tax is imposed on all fuel, while decrease by about 0.06 percent if carbon tax is imposed on either petrol or diesel compared to an economic situation if the carbon tax is not imposed. The increase in price level not only would reduce real wage, but also export volume. The increase in domestic price level would raise the export price index. It then reduces competition of domestically produced output in the world market. The increase in export price index would decrease the demand for export by about 0.4 percent if carbon tax is imposed on all fuel; and about 0.2 percent if carbon tax is imposed on either fuel compared to an economic situation if carbon tax is not imposed. The demand for imported commodities would also decrease as employment and real wage decrease. These linkages between economic activities explain the effect of carbon tax on economy in general.

While the first three columns shows the effect of carbon tax on fuel commodity only, the fourth column shows the effect on macroeconomics variable if carbon tax is imposed on all commodities. In addition, unlike the first three simulations where carbon tax is imposed on all fuel users, carbon tax in the fourth simulation is imposed on producer only. The same percent of carbon tax is imposed on the first three simulations and the fourth simulation. Comparing the macroeconomics result of the first three simulations with the fourth simulation, the carbon tax on producer only would affect the economy more adversely than the policy where carbon tax is imposed on all fuel users. It may due to the carbon tax is imposed on all commodities, instead of on fuel commodities only; and the carbon tax on all commodities is borne by producer only. Carbon tax on all commodities would raise the price level higher than if carbon tax is imposed on fuel commodities only. In the fourth simulation, the increase in consumer price level is 2 percent higher than the first simulation. The higher inflation in the fourth simulation compared to the first three simulation might explain the less desired performance in gross domestic product, consumption, employment, export volume and import volume.

Among the seven simulations, the reduction in fuel subsidy brings a more adverse effect on nominal gross domestic product. A 5 percent reduction in fuel subsidy might lead the nominal GDP being 125 percent lower than it would be if subsidy on all fuel is not reduced. The reduction in fuel subsidy decreases the consumer price level by about 12 percent in the fifth simulation and about 6 percent in the last two simulations compared to a situation where the fuel subsidy is not reduced. Intuitively, the reduction in fuel subsidy may bring a more direct impact on fuel users compared to carbon tax on fuel commodity. The reduction in fuel subsidy would then increase fuel price. It might lead to a more efficient level of fuel consumption. It means that the higher fuel price would encourage fuel users to use less fuel compared to before. Since fuel expenses is an expenditure for household, the reduced expenditure on fuel might then decrease expenditure of household, by about 12 percent if subsidy on all fuel is reduced and by about 6 percent if subsidy on either fuel is reduced compared to an economic situation where fuel subsidy is not reduced. The less household consumption might then put a downward pressure on price level. The decrease in price level in the three simulations is proportionate to the decrease in household consumption. As consumption is a component of gross

domestic product, the decrease in household consumption would then decrease the national output. The national output in the case where fuel subsidy decreases more compared to a situation where carbon tax is imposed. It may due to lower private consumption after fuel subsidy is reduced. The lower demand for output would then decrease aggregate employment since less output is produced after fuel subsidy is imposed. The aggregate employment would reduce by 11 percent if subsidy in all fuel is reduced and by 5.5 percent if subsidy on either fuel is reduced compared to a situation where fuel subsidy is not reduced. As export is also a component in gross domestic product, the lower national output would indicate the output produced for export is also lower. Gross domestic product, consumption and employment contract more than when subsidy on all fuel is reduced compared to when subsidy on either fuel is reduced. Consequently, the export demand reduces in a larger extent if subsidy on both type of fuel is reduced compared to if subsidy on either type of fuel is reduced. The demand for imported commodities decreases in the last simulations due to the lower domestic price level. The import volume also reduces more in the fifth simulation compared to the sixth and the last simulations.

Thus in terms of desired macroeconomics effect, carbon tax would be a better policy than reducing fuel subsidy. However the carbon tax would cause a higher inflation than reducing fuel subsidy.

Industry Effect

Sector	Simulation						
	1	2	3	4	5	6	7
Agriculture:							
Paddy	-0.37	-0.18	-0.19	-6.61	-27.99	-13.90	-14.09
Rubber	-0.10	-0.05	-0.05	-2.52	-0.74	-0.34	-0.40
Oil Palm	-0.77	-0.37	-0.39	-6.91	-13.75	-6.77	-6.99
Fishing	-0.28	-0.13	-0.14	-3.49	-1.10	-0.56	-0.55
Mining:							
Crude Oil and Natural Gas	-0.02	-0.01	-0.01	-0.17	0.02	0.01	0.01
Metal Ore Mining	-1.07	-0.52	-0.55	-12.41	12.46	6.23	6.23
Stone Clay and Sand Quarrying	-0.55	-0.27	-0.28	-3.30	-26.59	-13.39	-13.19
Other Mining and Quarrying	-0.11	-0.06	-0.06	-2.04	5.12	2.63	2.49
Manufacturing:							
Iron and Steel Products	-0.75	-0.36	-0.38	-9.95	-42.81	-21.47	-21.34
Motor Vehicles	-0.19	-0.09	-0.10	-2.63	1.78	0.96	0.83
Motorcycles	-0.54	-0.26	-0.28	-10.43	-10.33	-5.16	-5.16
Other Transport Equipment	-0.19	-0.09	-0.10	-3.51	-9.47	-4.69	-4.78
Service:							
Electricity and Gas	-0.14	-0.07	-0.07	-5.40	7.27	3.70	3.58
Land Transport	-0.59	-0.29	-0.30	-5.70	-11.38	-5.71	-5.67
Water Transport	-0.58	-0.28	-0.30	-6.51	-16.02	-8.25	-7.77
Air Transport	-0.37	-0.18	-0.19	-4.28	-18.12	-9.16	-8.97
Other Transport Services	-0.46	-0.22	-0.23	-4.64	-19.15	-9.97	-9.19

Table 2: Change in Industry Output After Shock

This table shows the change in output of some industries that are closely linked with fuel as their intermediate input. Both the carbon tax and reduction in fuel subsidy by 5 percent might lead the industry output being lower than it would be if the two policies are not implemented. While both policies would generate a negative impact on industry output, the negative impact on industry output is lesser in the former policy. The industry output in the last three simulations decreases more than the

first four simulations. Comparing the four simulations related with carbon tax, imposing carbon tax on either petrol or diesel would reduce employment by industry at a lesser extent compared to imposing carbon tax on both petrol and diesel and also on producer.

Comparing the four simulations related with carbon tax, imposing carbon tax on either petrol or diesel would reduce industry output at a lesser extent compared to imposing carbon tax on both petrol and diesel and also taxing on producer. Comparing the change in industry output in the agricultural sector, mining sector, manufacturing sector and service sector, the carbon tax policy brings the least effect on transport sector. It may due to its elastic demand for fuel as its intermediate input. Producer in the transport sector would not reduce its output much although fuel price is increased when carbon tax is imposed. Thus although carbon tax is imposed, its output does not decrease much compared to other sectors. The output in land transport industry would be lower by 0.3 percent if carbon tax is imposed on either fuel; and by 0.6 percent if carbon tax is imposed on all fuel than it would be if carbon tax is not reduced. Among the land transport, water transport, air transport and other transport service. the least affected industry is the second industry. It may due to lower fuel consumption in this industry compared to other transport industry.

Compared to transport sector, output in the agriculture, mining and manufacturing sectors increases at a larger extent. As the increase in fuel price would raise the production cost, producer would react to reduce output. In agriculture sector, the paddy industry would decrease its output by around 0.4 percent if the carbon tax is imposed on all type of fuel; half if the carbon tax imposed on all type of fuel compared to a situation where the carbon tax is not imposed. The most adversely affected industry is the metal ore mining industry. Its output is one percent lower than it would be if the carbon tax is not imposed on all type of fuel.

Sector	Simulation						
	1	2	3	4	5	6	7
Agriculture:							
Paddy	-0.69	-0.33	-0.35	-12.38	-52.40	-26.02	-26.38
Rubber	-0.43	-0.21	-0.22	-11.33	-3.32	-1.53	-1.79
Oil Palm	-1.69	-0.82	-0.87	-15.23	-30.31	-14.91	-15.39
Fishing	-1.19	-0.58	-0.61	-15.06	-4.77	-2.40	-2.36
Mining:							
Crude Oil and Natural Gas	-1.06	-0.52	-0.54	-10.99	1.23	0.51	0.72
Metal Ore Mining	-3.40	-1.65	-1.75	-39.62	39.80	19.90	19.90
Stone Clay and Sand Quarrying	-1.56	-0.76	-0.80	-9.38	-75.53	-38.05	-37.48
Other Mining and Quarrying	-0.65	-0.31	-0.33	-11.55	28.92	14.86	14.06
Manufacturing:							
Iron and Steel Products	-2.87	-1.40	-1.47	-38.31	-164.77	-82.62	-82.15
Motor Vehicles	-0.47	-0.23	-0.24	-6.65	4.51	2.42	2.09
Motorcycles	-1.27	-0.62	-0.65	-24.55	-24.32	-12.16	-12.16
Other Transport Equipment	-1.00	-0.48	-0.51	-18.16	-48.97	-24.24	-24.73
Service:							
Electricity and Gas	-1.64	-0.80	-0.84	-61.80	83.30	42.33	40.97
Land Transport	-1.13	-0.55	-0.58	-10.91	-21.78	-10.92	-10.86
Water Transport	-4.01	-1.95	-2.06	-44.78	-110.25	-56.79	-53.46
Air Transport	-0.56	-0.27	-0.29	-6.47	-27.42	-13.85	-13.57
Other Transport Services	-1.76	-0.85	-0.90	-17.86	-73.68	-38.33	-35.34

Table 3: Change in Employment by Industry After Shock

This table shows the change in employment of some industries that are closely linked with fuel as their intermediate input. The result pattern in employment by industry is almost the same as the

change in industry output in the Table 2. Same as the Table 2, both the carbon tax and reduction in fuel subsidy by 5 percent might lead the same effect on employment by industry. Both the carbon tax and reduction in fuel subsidy by 5 percent might lead the employment by industry being lower than it would be if the two policies are not implemented. While both policies would generate a negative impact on industry output, the negative impact on employment is lesser in the former policy. Thus ame as the Table 2, the carbon tax would affect the industry more than the reduction in fuel subsidy, in terms of employment by industry. The employment by industry in the last three simulations decreases more than the first four simulations. Comparing the four simulations related with carbon tax, imposing carbon tax on either petrol or diesel would reduce employment by industry at a lesser extent compared to imposing carbon tax on both petrol and diesel and also on producer.

However, unlike the result pattern in the Table 2, the carbon tax policy brings the worse effect in transport sector among the four sectors. The increase in production cost and efficiency in fuel consumption might cause producer to substitute capital for labour. The primary factor substitution might be explained by the adoption of capital intensive transport that is more environmentally friendly after the fuel price is increased by carbon tax. The reduced employment and the technology improvement in transport sector would not affect its output, as shown in the Table 2.

Consequently, compared to the transport sector, change in output in the agriculture, mining and manufacturing sectors is lesser. As the increase in fuel price would raise the production cost, producer would react to reduce its demand on another type of input – labour. In agriculture sector, the paddy industry would decrease its output by around 0.7 percent if the carbon tax is imposed on all type of fuel; half if the carbon tax imposed on all type of fuel compared to a situation where the carbon tax is not imposed. The most adversely affected industry is the metal ore mining industry, since its output contraction is the most among the sectors. Its employment is four percent lower than it would be if the carbon tax is not imposed on all types of fuel. Producer in this industry decreases its employment more than output. It may due to tendency to shift to fuel-saving capital after production cost is raised by the carbon tax.

CONCLUSION AND POLICY IMPLICATION

In overall, both carbon tax and fuel subsidy would affect the economy negatively. Comparing the effect on macroeconomics variables, output and employment by industry, carbon tax might be a better policy in handling emission produced by land transport. Although carbon tax on fuel brings less negative impact on economy compared to the reduction in fuel subsidy, it comes with a tradeoff: the former policy would increase the consumer price index. The benefit and cost of policies would give a direction for policymaker to determine which policy to be implemented in order to reduce carbon intensity by 40 percent in 2020 as agreed by the Prime Minister in COP15.

No matter which policy is implemented, it is proper for the policy to be implemented gradually. As a suggestion, the carbon tax and reduction in fuel subsidy might be imposed on goods vehicle first. It is because the number of goods vehicle is less but its emission is much compared to other vehicle. Since the goods vehicle is mainly used by producer only as their transport and does not involve much parties, taxing and reducing subsidy on fuel consumed goods vehicle only would be the first and appropriate step in reducing CO^2 emission successfully. Compared to the fourth simulation, the carbon tax and subsidy reduction on fuel consumed by goods vehicle only would reduce the negative impact on gross domestic product, industry output and employment than shown in the above tables.

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